Finding Your Place With Core Location

Session 119

These are confidential sessions—please refrain from streaming, blogging, or taking pictures.

Finding Your Place With Core Location

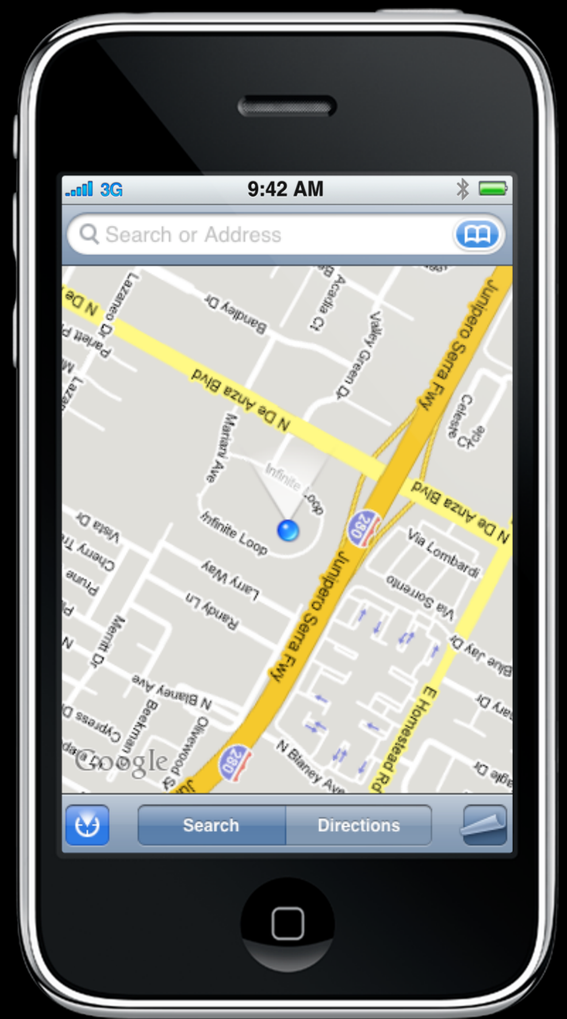
Patrick Piemonte
iPhone Software Engineer

Why Location?

9:42 AM
Nearby
Hot On Yelp Nearby
1. Ike's Place
3506 16th St, Castro
849 Reviews
Sandwiches
2. Bi-Rite Creamery
3692 18th St, Mission
1529 Reviews
Ice Cream & Frozen...
3. Bombay Ice Creamery
552 Valencia St, Mission
302 Reviews
Ice Cream & Frozen...
4. Pizzeria Delfina
3611 18th Street, Mission
679 Reviews
Pizza
5. Otoro Sushi
205 Oak Street, Hayes Valley
21 Reviews
Japanese
Nearby
Feed
Search
Recents
Bookmarks
brightkite
I am at...
Fourbarrel Coffee
375 Valencia St, San Francisco, CA
Last Update: N/A
Accuracy: N/A
FIND ME
or
PICK A PLACE
and I want to...
Check In
Check In & Post a Note
Check In & Post a Photo
You are not currently checked in.
I am...
Friends
Nearby
Universe
More
Store Finder
Store Info
Store Info
City Lights Books
Bookstore
261 Columbus Avenue
San Francisco, California 94133-4586
(415) 362-8193
http://www.citylights.com/
Description
Independent bookseller and publisher specializing in literary fiction. radical politics, social theory, third - world and ethnic studies, cutting - edge poetry, arts,
Book Lists
Book Search
Store Finder
About
Result List
Search Here
Next 10
Search
Saved
Trackables
Settings
Help
Obama '08
Local Events
Obama Table at Lee Dist...
Lee District RECenter
Tomorrow
Obama Table at the Metros
Huntington, Van Dorn, & Franco...
Tomorrow
GCC Last Chance to Reg...
Germanna Community College...
Tomorrow
Oct 3 On the Way to Wat...
Taintor Farm, Waterford, Virginia
Tomorrow
Obama Art Fund Raiser...
Taintor Farm
Tomorrow
Calling All Cooks - Obam...
Obama Headquarters
Tomorrow
Southern Fairfax Phone...
Richmond Highway Office
Tomorrow
Obama Mamas & Pa...
Monkey Business (a great play...
Tomorrow
Voter Registration Drive
Master Cuts Barber Shop
Tomorrow
Barack Obama's Campai...
Tomorrow
piemonte
Nearby
2 km
Patrick
Our session will certainly provide some "direction" :)
Chris
You had me at "On belay"
Rob
The new Core Location APIs are sweet.
Ron
WWDC09 is going to be great!
Load more...

Core Location

Framework



Core Location

How?

1 - 3 km

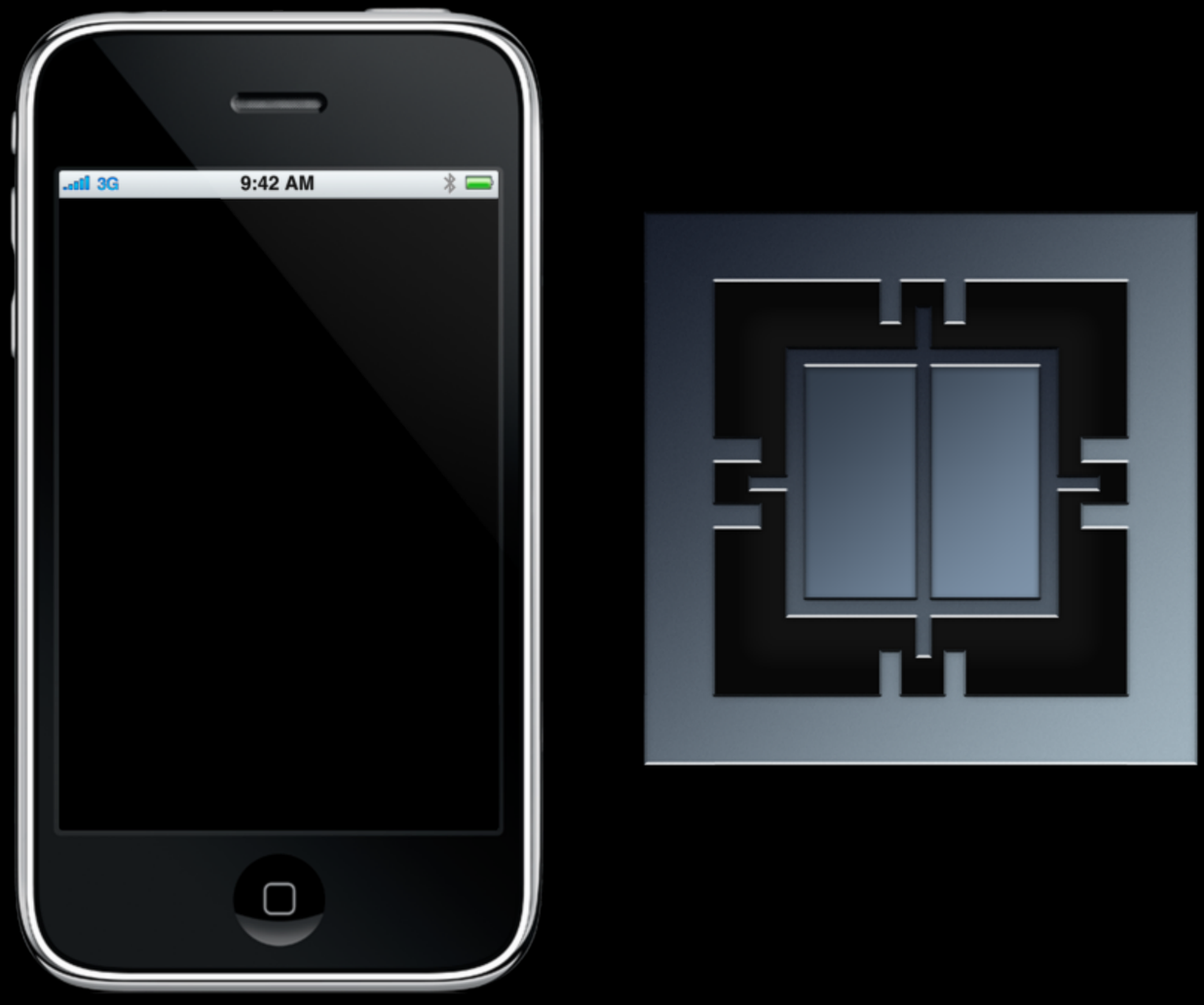
100 m

< 40 m

Core Location

Accelerometer allows us to measure changes in force

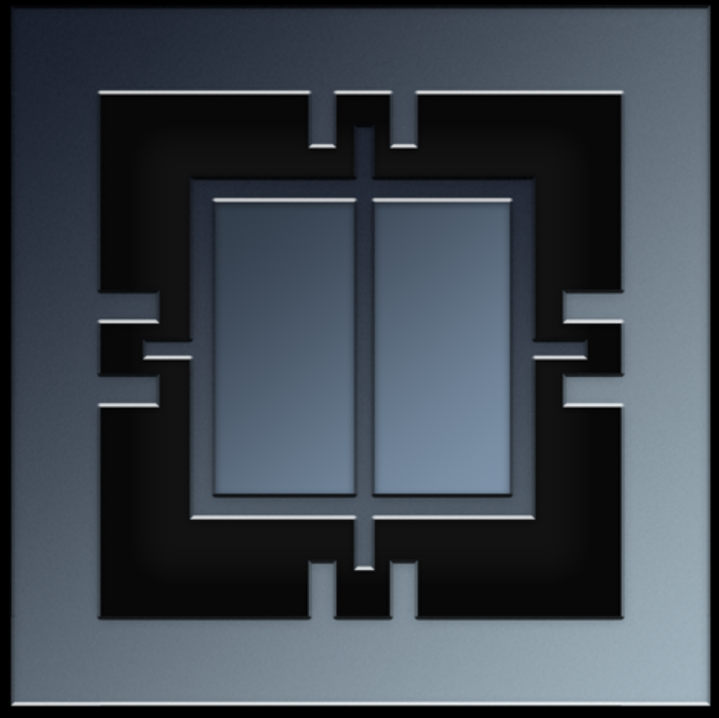
What is new?



Core Location

Core Location

What is new?



Accelerometer aids GPS tracking

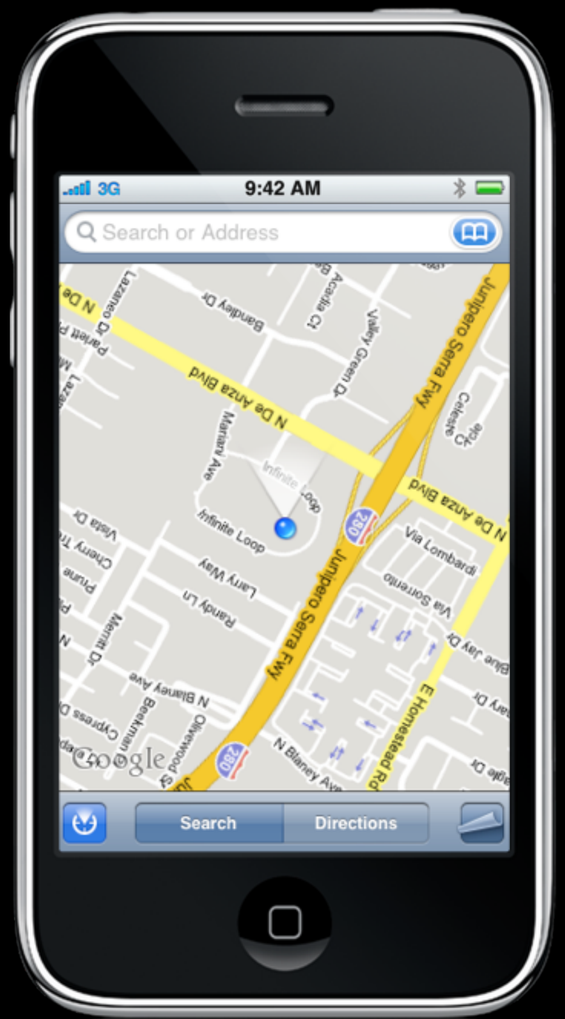
Core Location

What is new?

Compass

Core Location

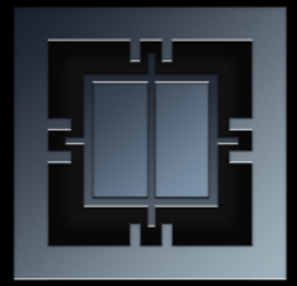
Complementary technologies



Cell

Compass

WiFi



Accelerometer

GPS

Core Location

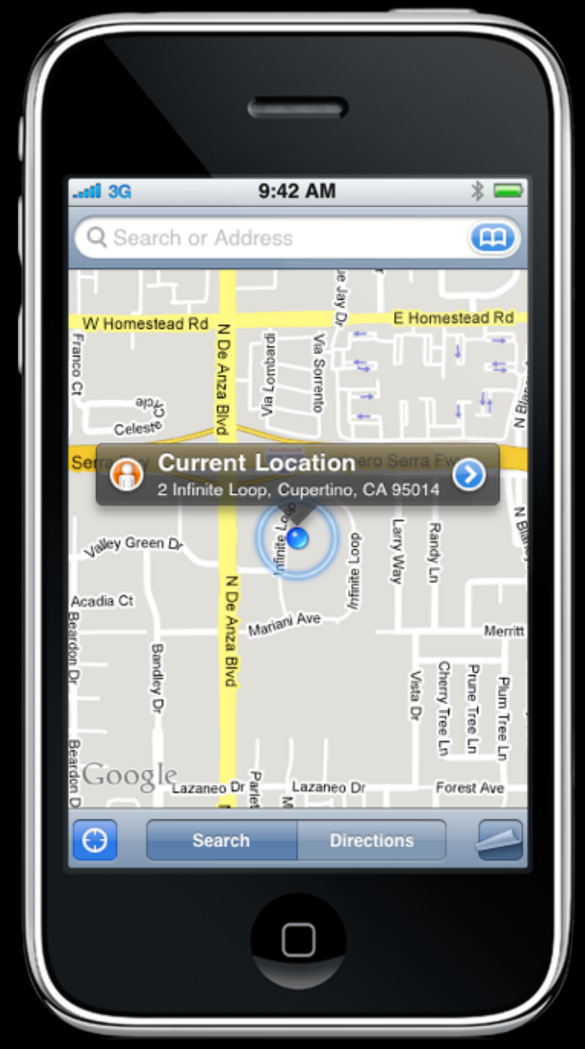
Using Core Location

Finding your location

Location

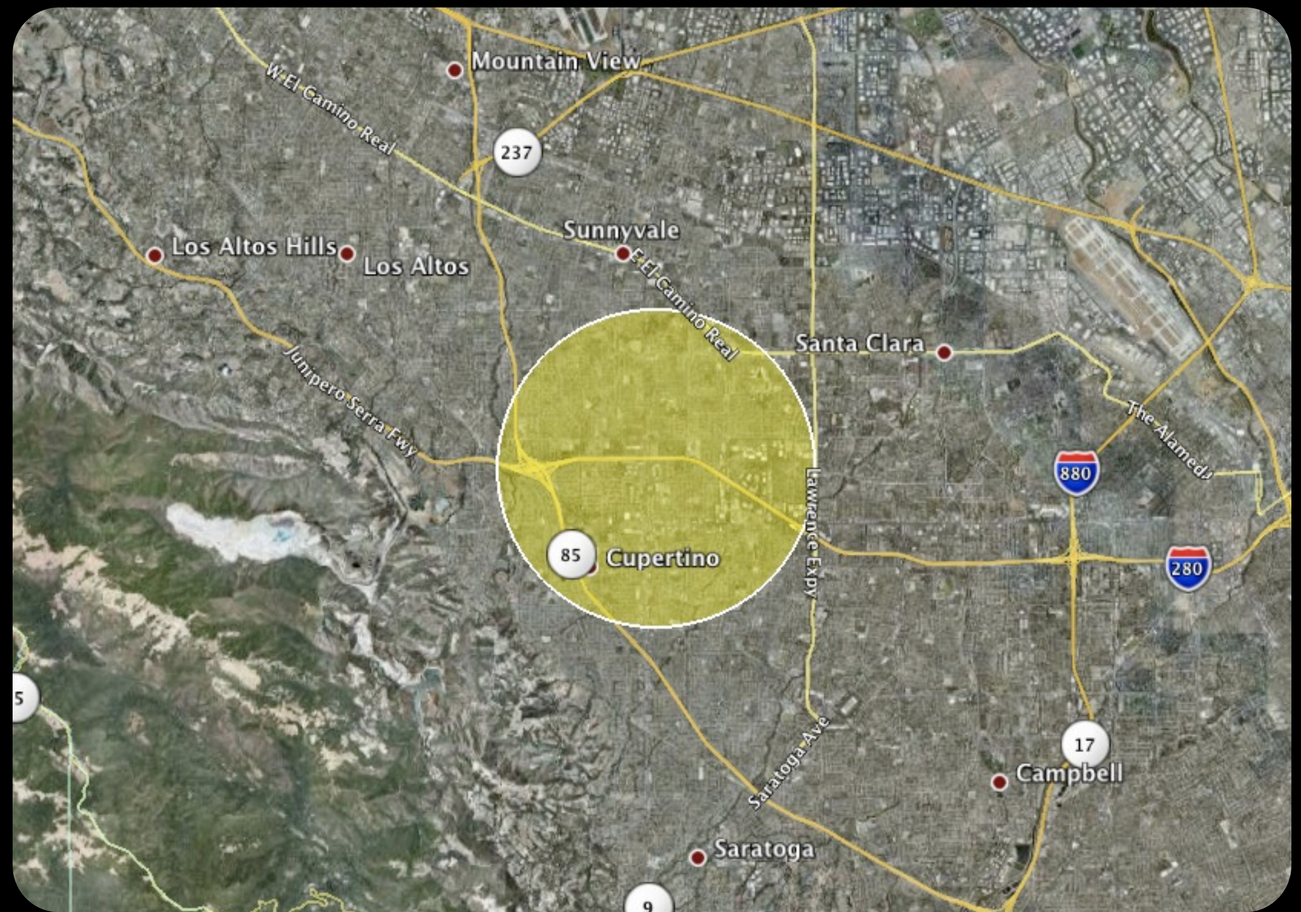
Your geographic position

- Latitude
- Longitude
- Altitude
- Accuracy, a measure of certainty



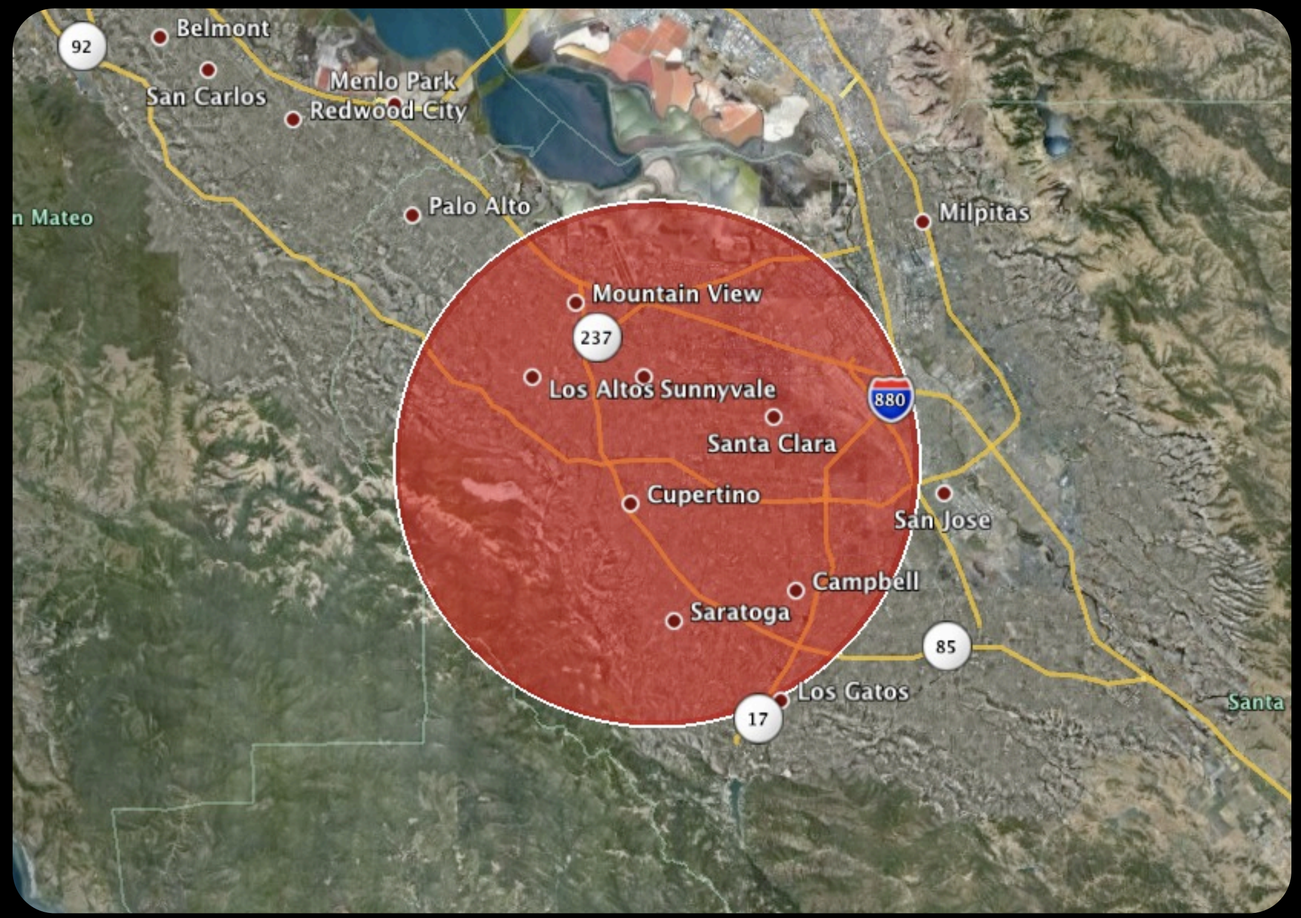
Cell

1 - 3 km



Lowest latency and power requirements

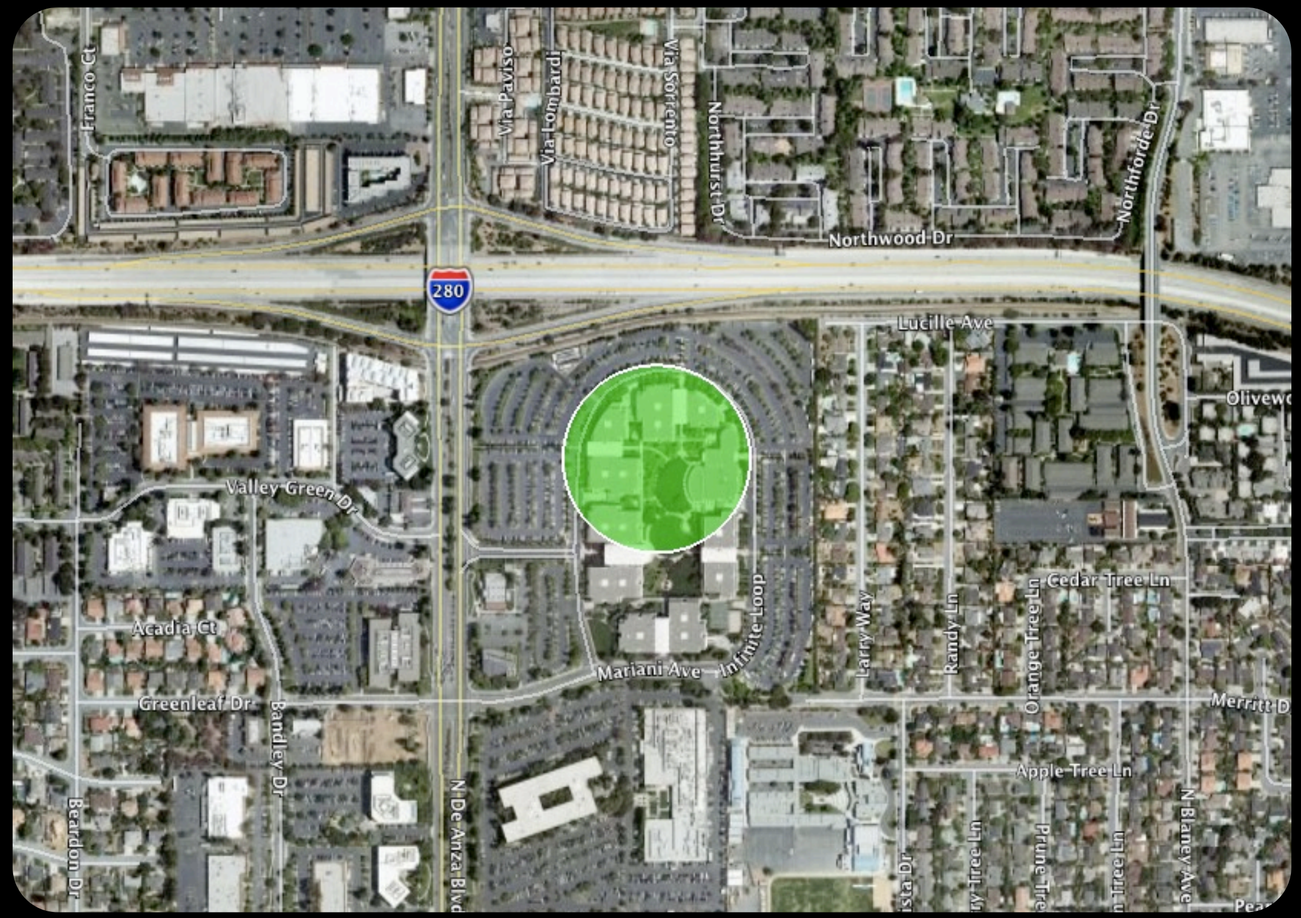
Cell



Cell is capable of quickly providing a ~12 km position

WiFi

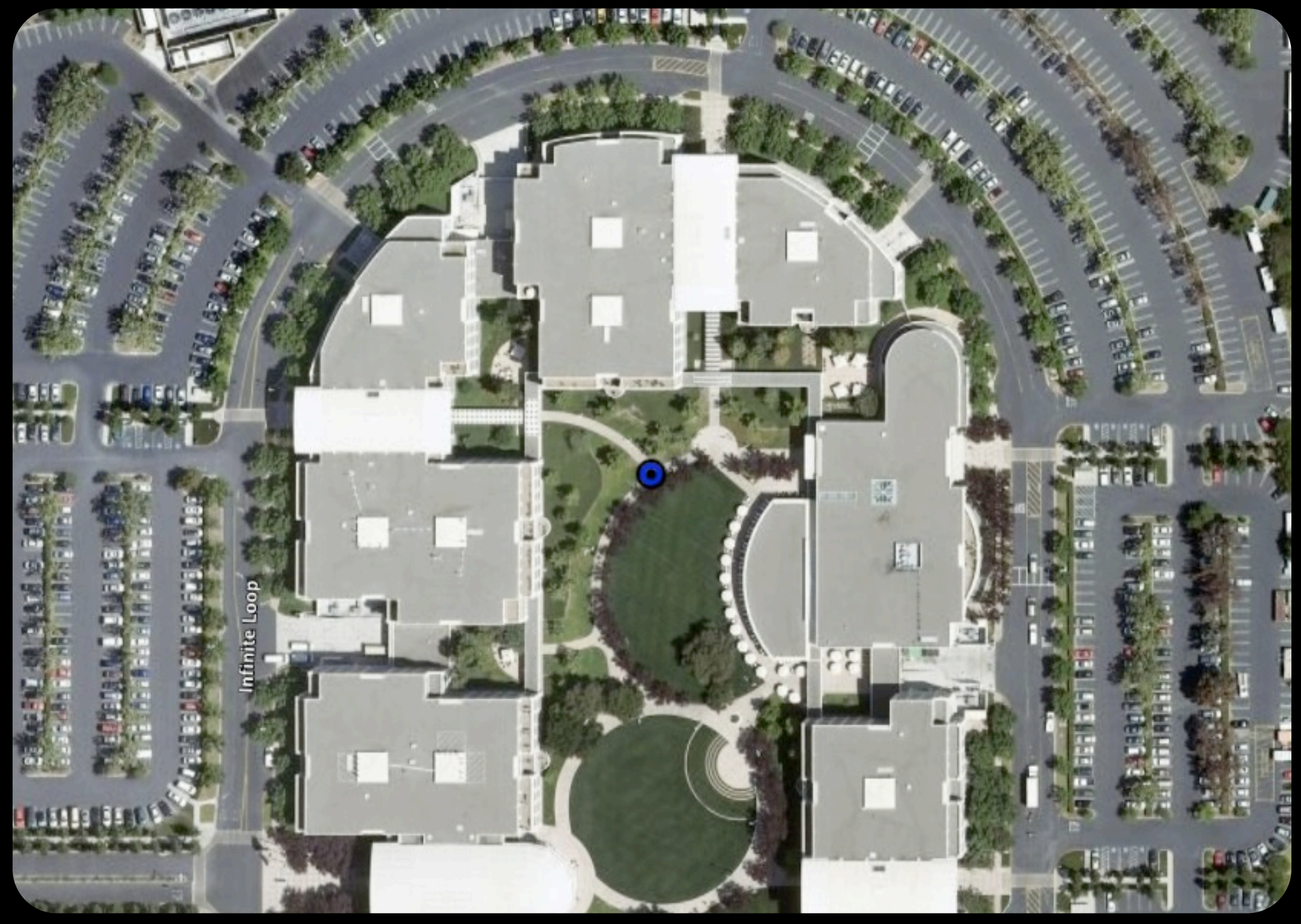
100 m



More precise than Cell but also uses more power

GPS

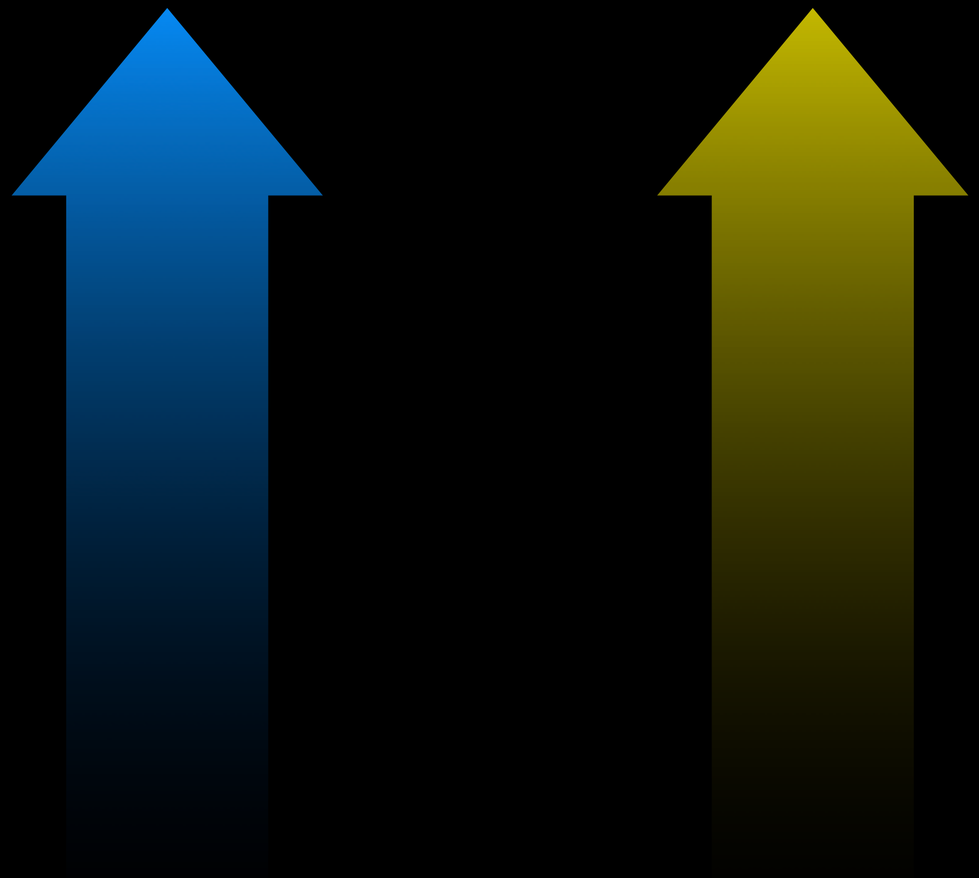
< 40 m



More power intensive, but provides heartbeat updates as well as speed and course

Location Technology

Accuracy and latency

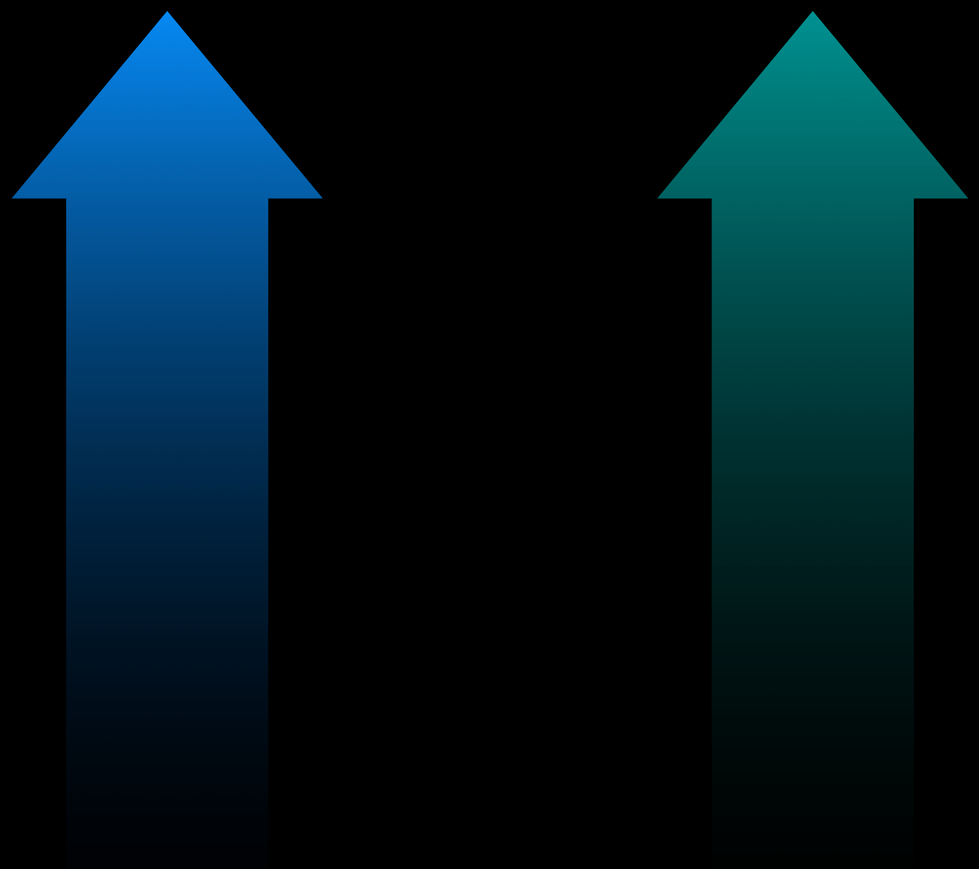


More Precise
the Accuracy

More Time
to Calculate

Location Technology

Accuracy and power consumption

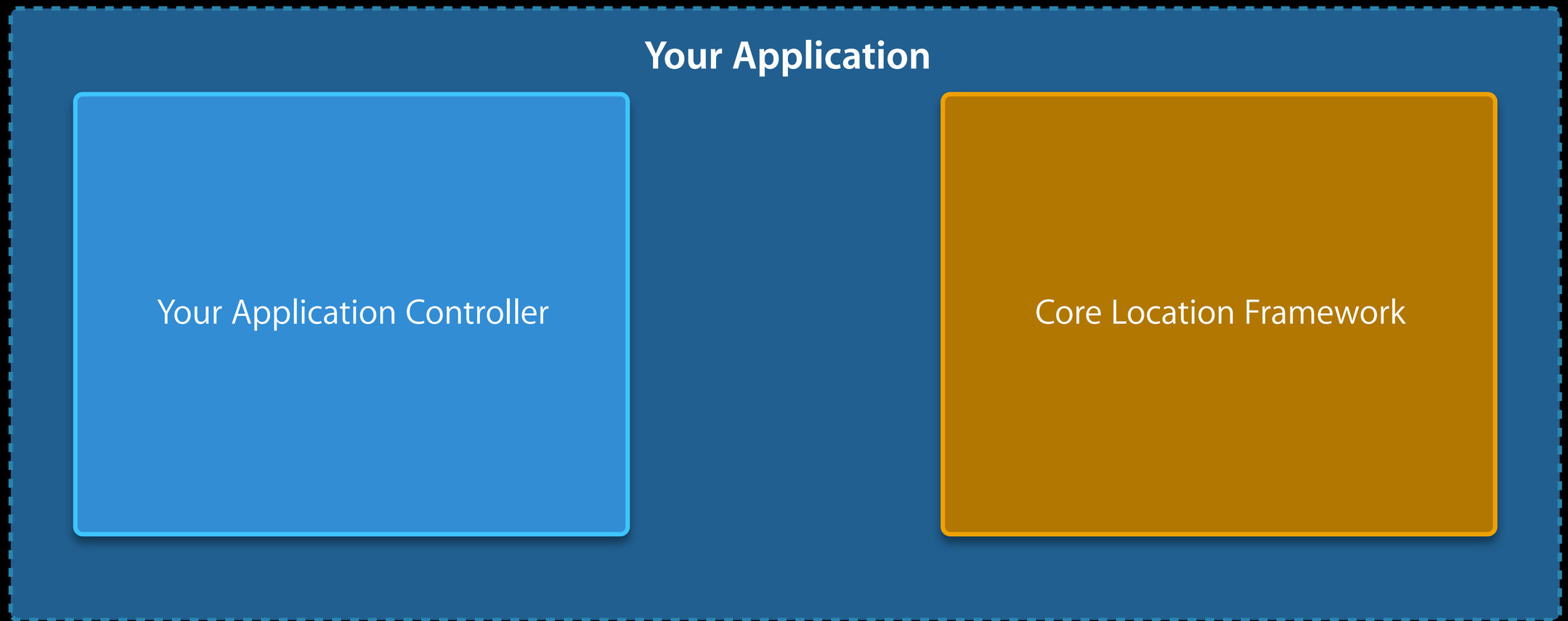


More Precise
the Accuracy

More Power
Consumed

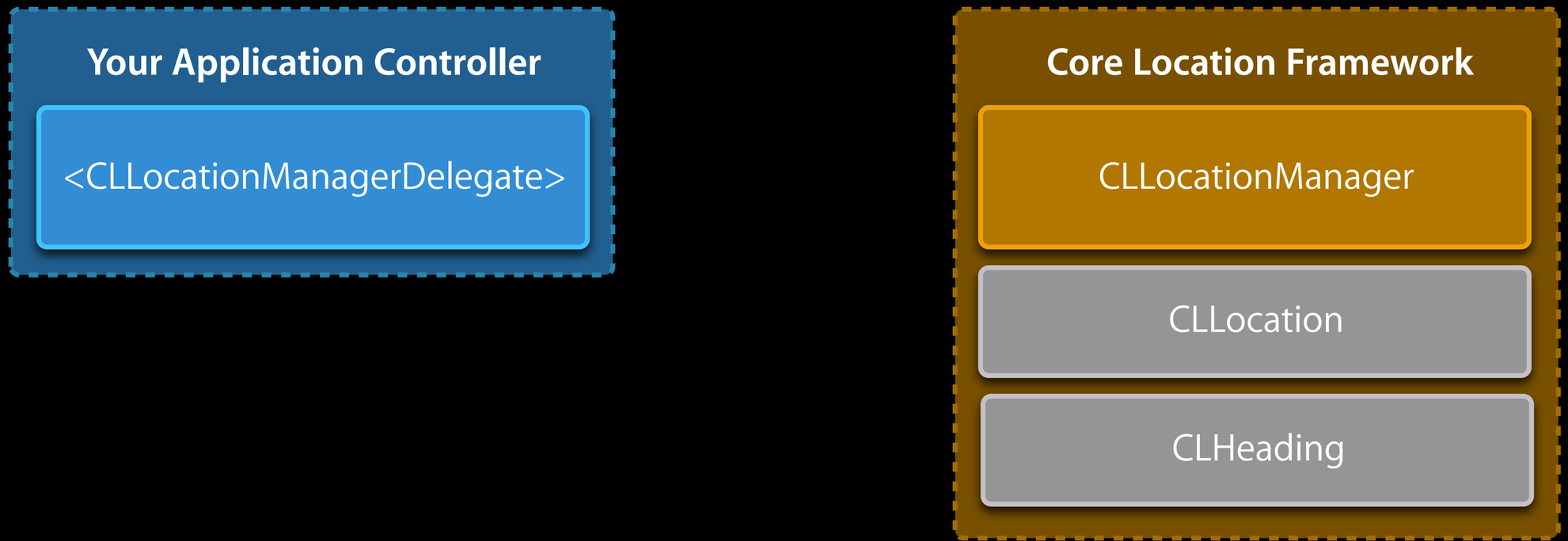
Primary Components

Setting up core location



Core Location Framework

Classes and protocols



Location API

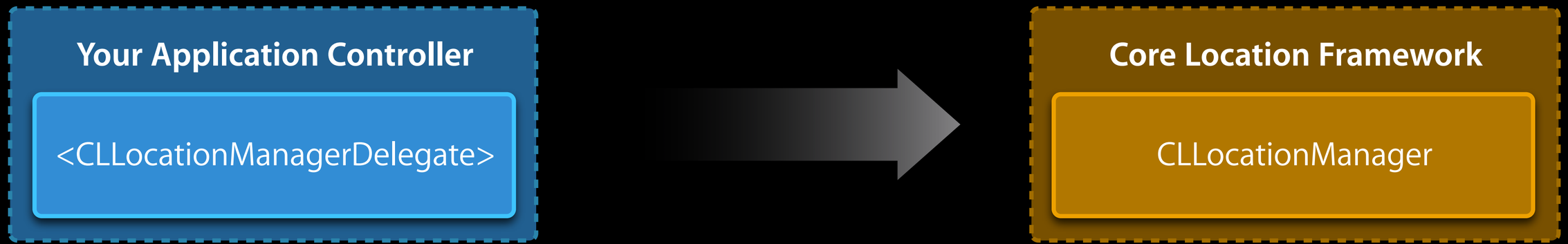
Configuring location manager

CLLocationManager

```
@property(assign, nonatomic) CLLocationAccuracy desiredAccuracy;
```

Location API

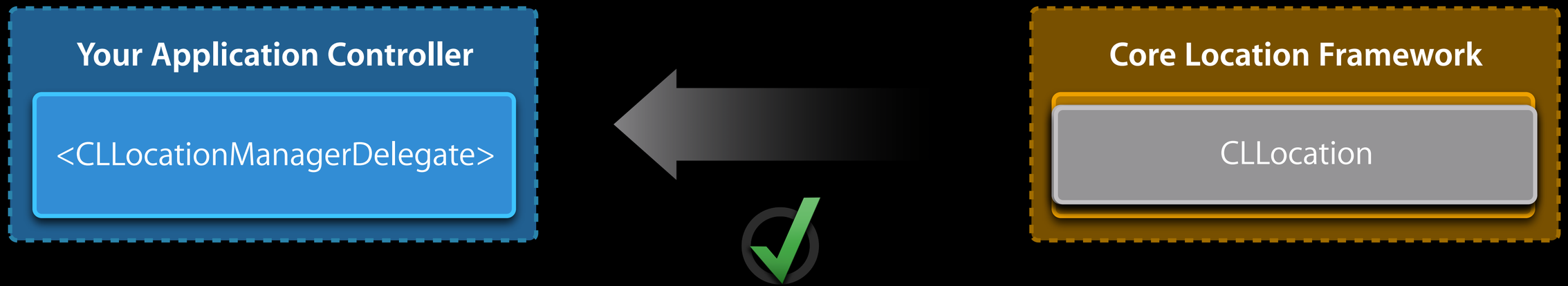
Starting location updates




```
startUpdatingLocation
```

Location API

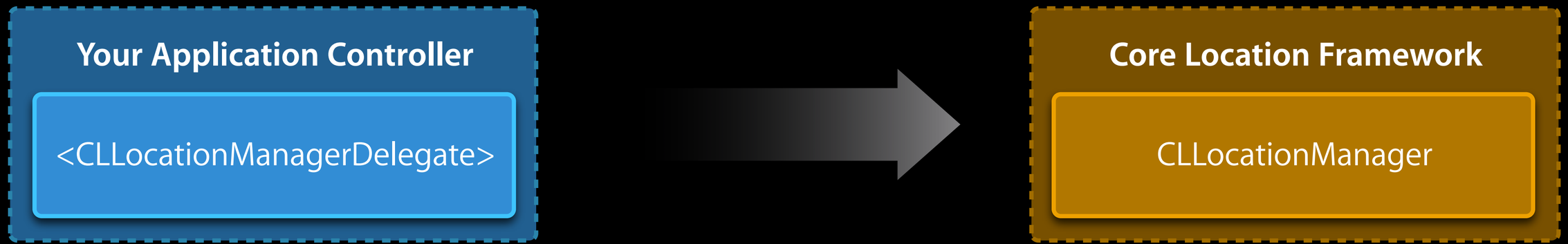
Receiving location updates




```
locationManager:didUpdateToLocation:fromLocation:
```

Location API

Stopping location updates




```
stopUpdatingLocation
```

Location API

Filter for selective updates

CLLocationManager

```
@property(assign, nonatomic) CLLocationDistance distanceFilter;
```

Location

Best practices

- Timestamps
- User authorization
- Error handling
- Conserving power with timers

Best Practices

Right place, right time

- Core Location caches location objects for efficiency
- Each location object has a timestamp
- Allows you to decide if a location is sufficient for your app

```
NSTimeInterval locationAge = -[newLocation.timestamp timeIntervalSinceNow];
```

CLLocation

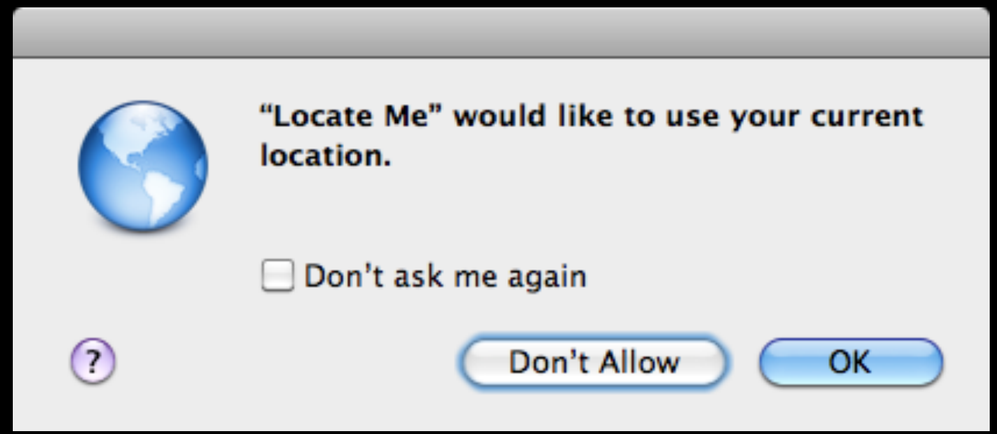
Best Practices

Location authorization and privacy

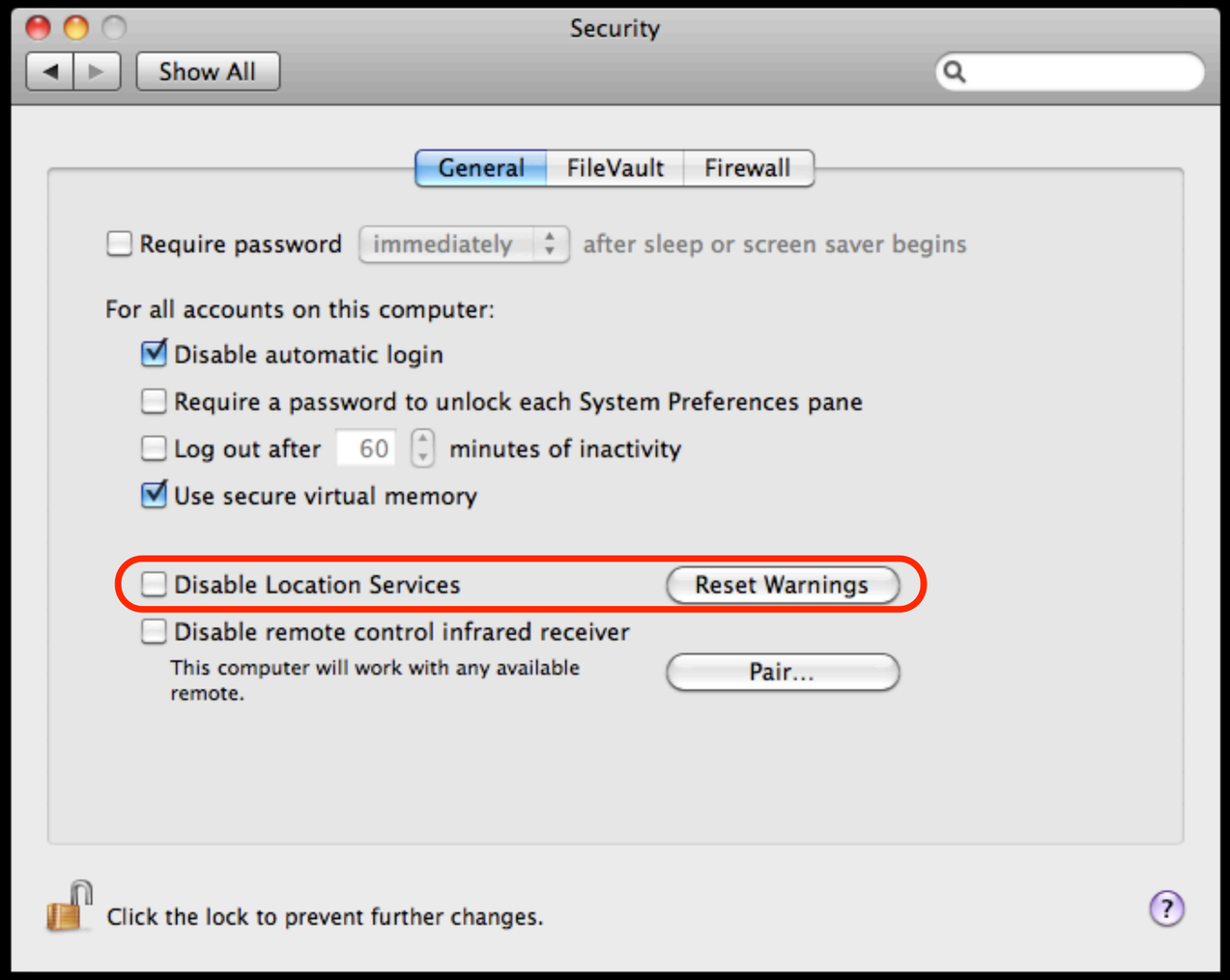
- Presented for each app
- Repeated twice until accepted
- Triggered when calling

```
startUpdatingLocation
```

- Plan for “Don’t Allow”



Best Practices



Best Practices

Avoid unnecessary prompting

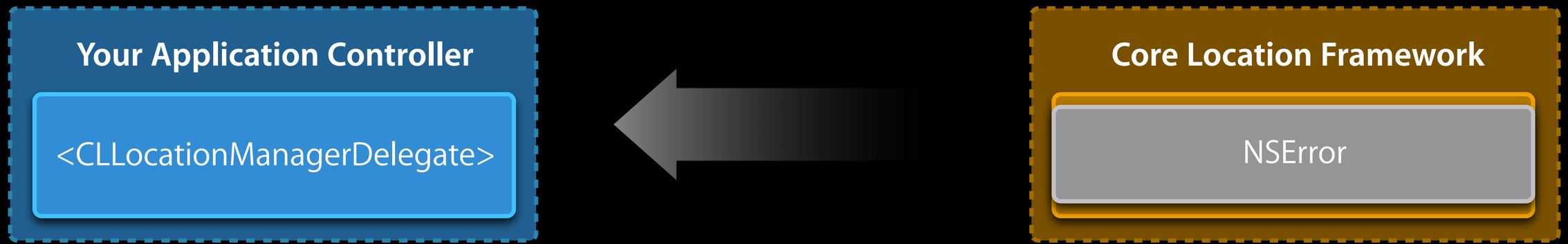
- Some of your users may have location disabled
- Check the services property before starting location updates

CLLocationManager

```
@property(readonly, nonatomic) BOOL locationServicesEnabled;
```

Location

Error handling




```
didFailWithError:
```

Best Practices

The codes

NSError Code	Description
kCLErrorDenied	User denied location services authorization
kCLErrorLocationUnknown	Temporary, device is in an area where location cannot be determined

Best Practices

Conserving power with timers

- Some environments make positioning difficult
  - Users enter a subway tunnel

- Waiting for a more precise accuracy will consume power
  - Set a timer when calling `startUpdatingLocation`
  - When the timer expires call `stopUpdatingLocation`

Best Practices

Conserving power with timers

- Be able to handle a temporary loss of location capabilities
  - Mac moves out of range from any WiFi networks
  - User disconnects external accessory GPS
- Notified with `kCLErrorLocationUnknown`
  - Call `stopUpdatingLocation` and set a timer
  - When the timer expires call `startUpdatingLocation`

Location Summary

- Location technologies
- Using the Location API
- Best practices

Using Core Location

Finding your direction

What Is Important About Direction?

Direction

Course

- Course, the direction you travel
- Property in CLLocation
- Computed based on your path of travel

Direction

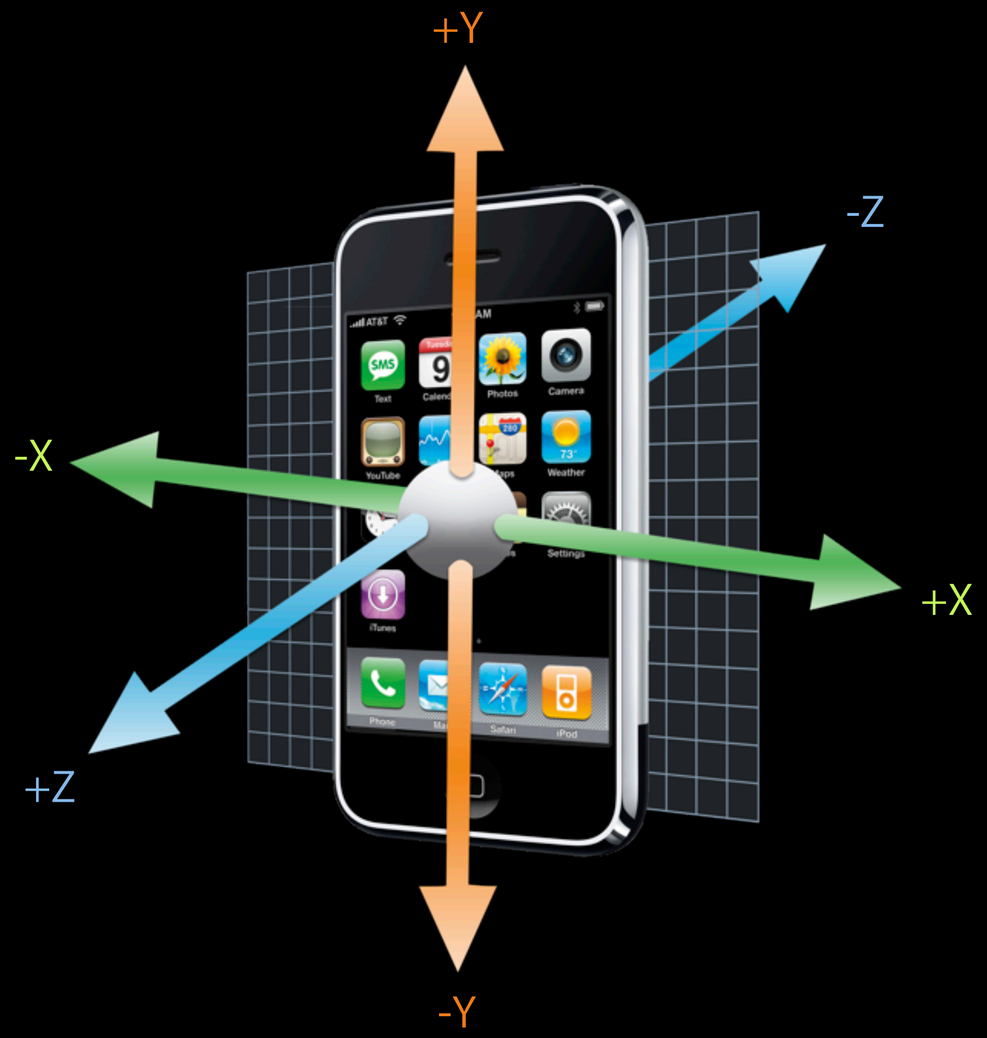
Heading

- Heading, the direction you face
- Available when stationary
- Provided by Compass
- Face one direction, travel in another

iPhone Compass

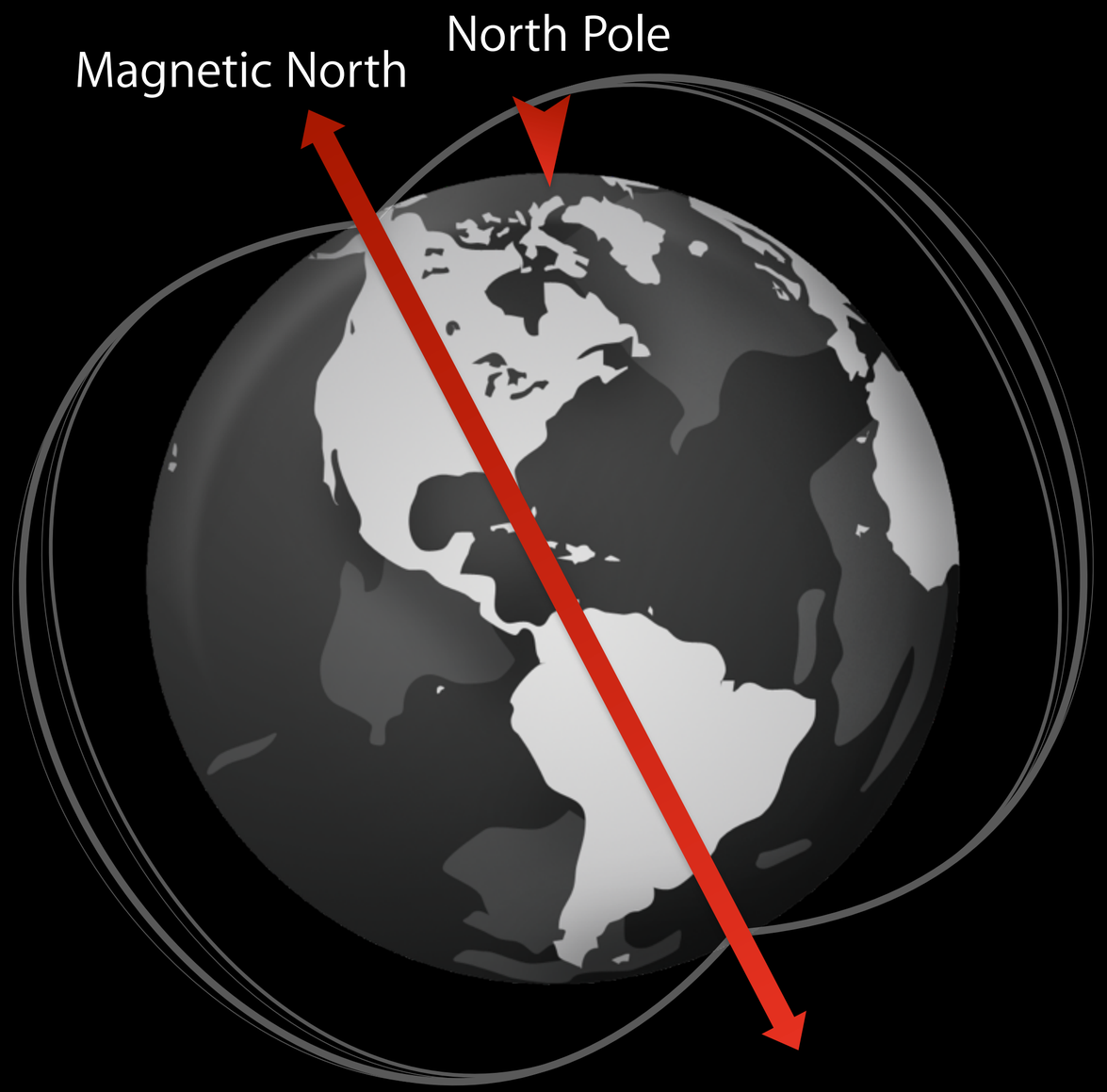
How does it work?

- Uses a magnetometer
- Orientation to magnetic North
- Uses same x,y,z axis as accelerometer
- x,y,z magnetic values



Magnetic North

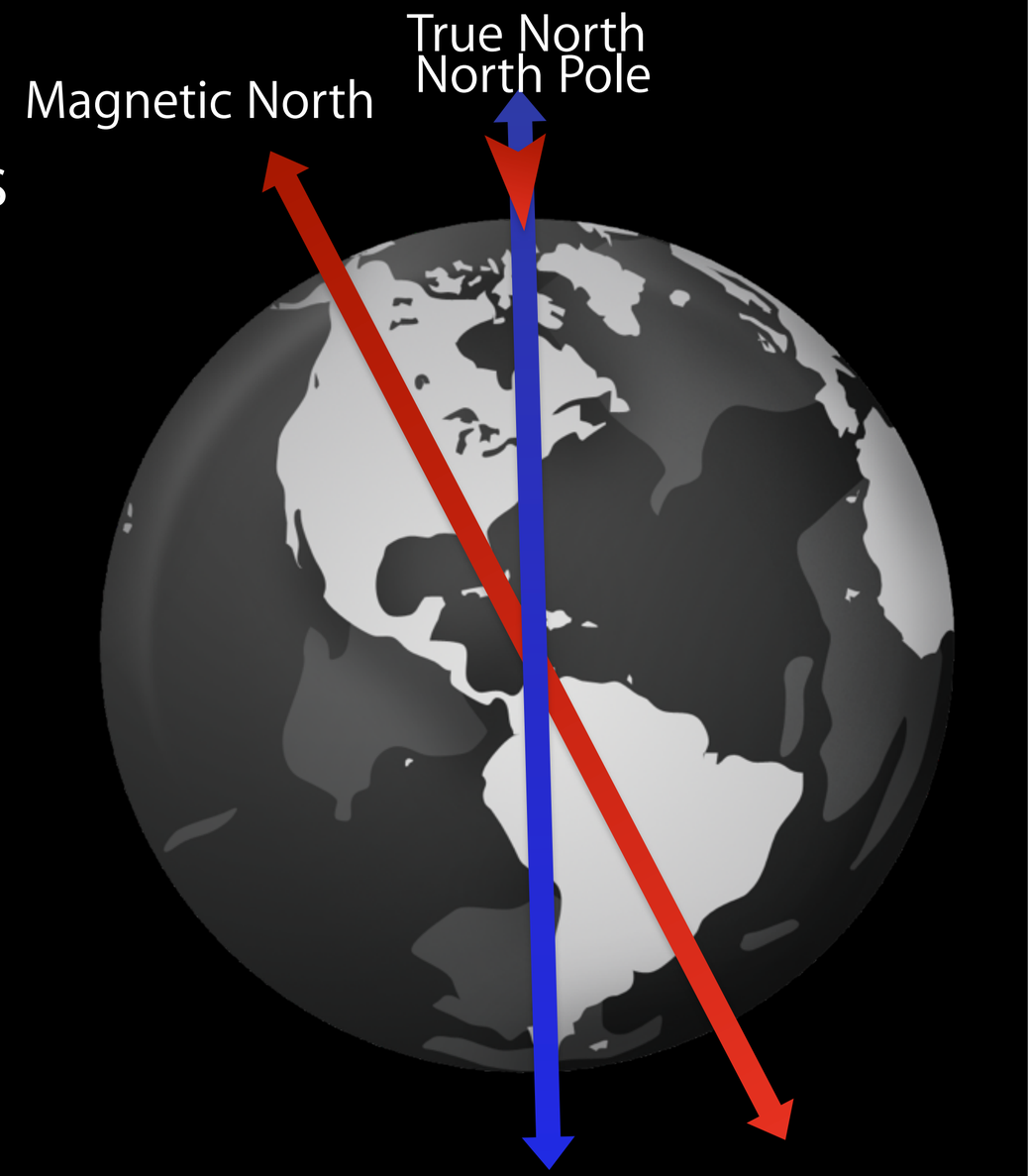
Direction of Earth's Magnetic Field



True North

Direction of the Earth's Geographic Poles

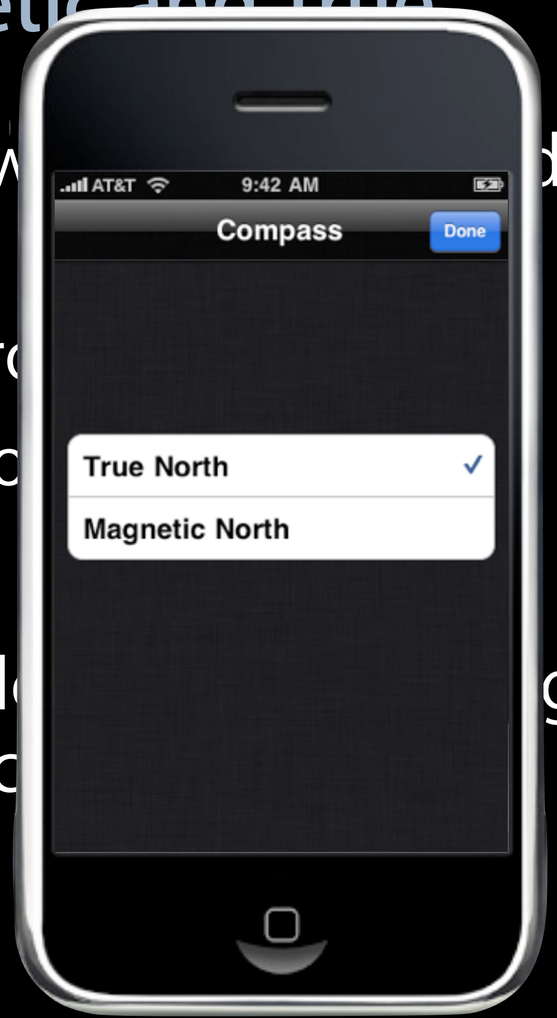
- Direction we are most familiar with
- Marked in the sky by the North Star, Polaris
- Reference point used when creating maps



True North

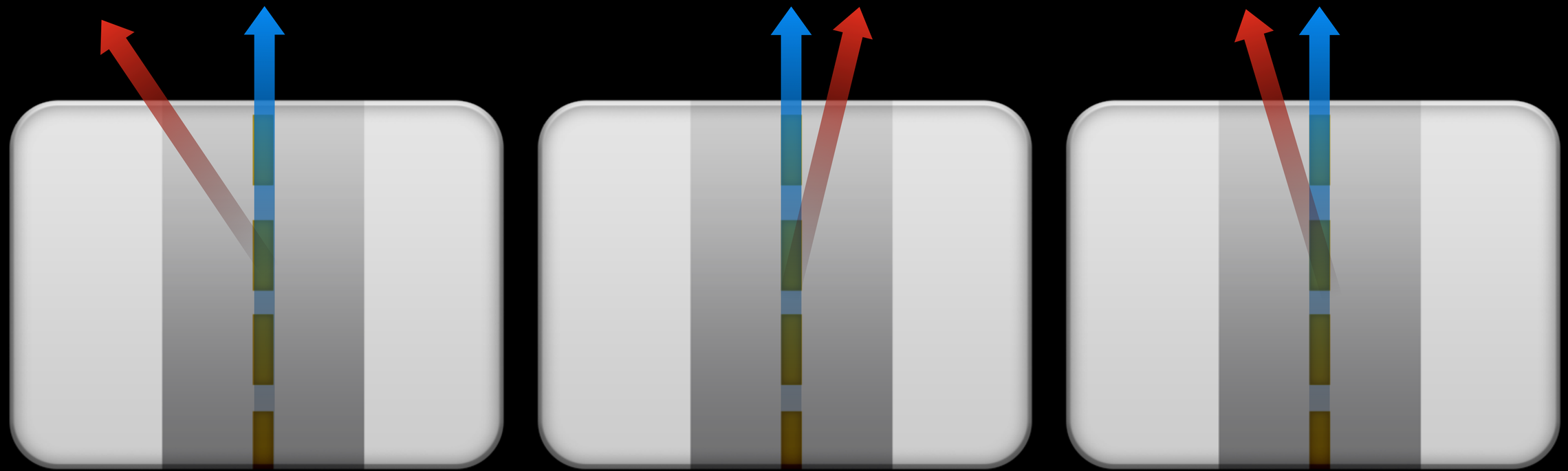
iPhone Provides Magnetic and True

- Magnetic compasses show ding on their location
  - In San Francisco, +14 º fr
  - In New York City, -14 º fr
- iPhone corrects this with l gy to provide the direction we c



Magnetic and True Heading

Magnetic will look incorrect with respect to a map



Paris, France
-38°

San Francisco, USA
+14°

New York City, USA
-14°

Heading API

Setup with the Location Manager

CLLocationManager

```
@property(readonly, nonatomic) BOOL headingAvailable;
```

```
@property(assign, nonatomic) CLLocationDegrees headingFilter;
```

Heading API

By design, similar to the Location API

- Start with `startUpdatingHeading`
- Delegate receives updates with `locationManager:didUpdateHeading:`
- Stop with `stopUpdatingHeading`

CLHeading

True Heading

Available when location is determined

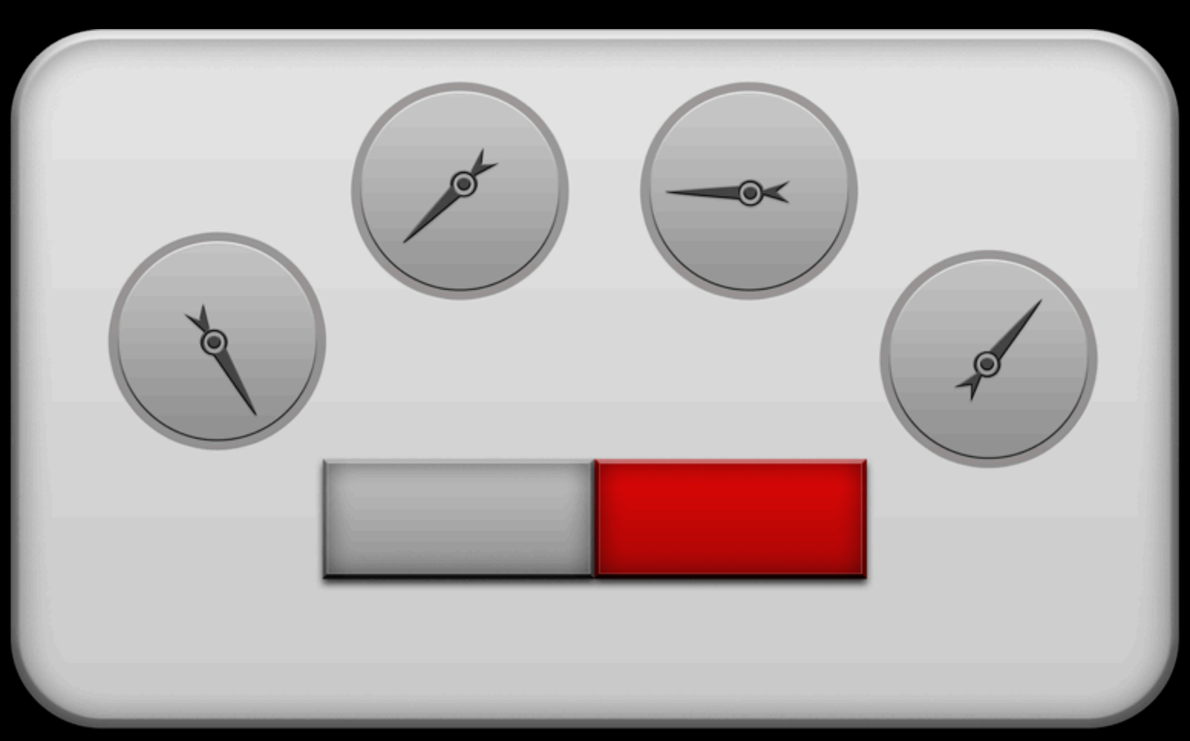
- Reported as -1.0 when location is unknown to device
- Rough location is sufficient
  - `kCLLocationAccuracyThreeKilometers`

Demo

Heading Accuracy

Interfering magnetic fields are everywhere

- Magnetic fields can come from your Mac and even your iPhone itself
- Compasses can align to fields other than the Earth's magnetic field



Heading Accuracy

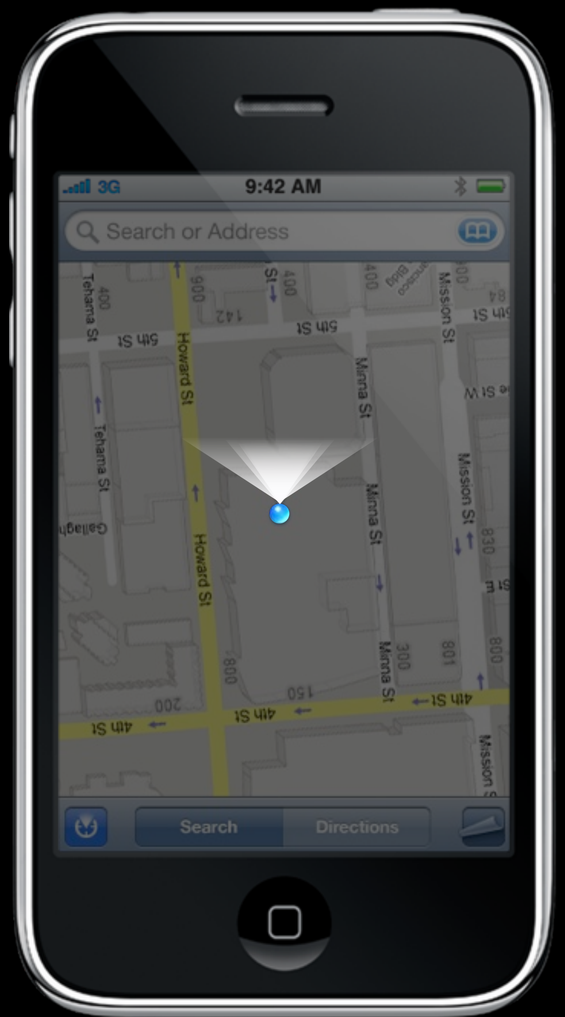
Accuracy reports certainty

CLHeading

```
@property(readonly, nonatomic) CLLocationDirection headingAccuracy;
```

Heading Accuracy

Small changes in magnetism

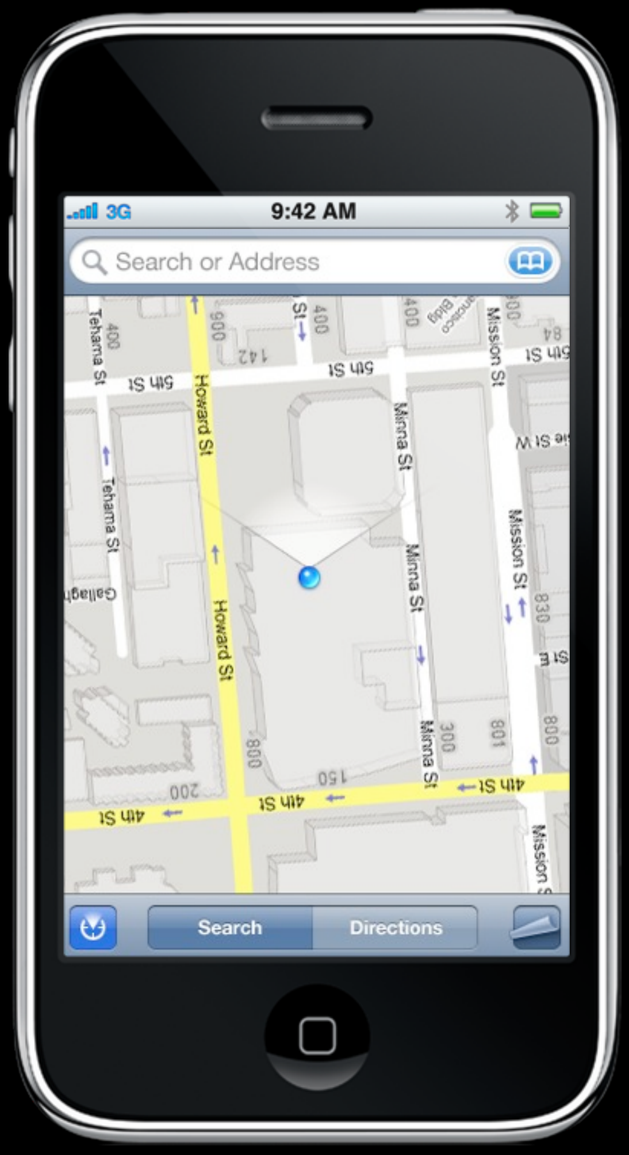


headingAccuracy

Heading Accuracy

Large changes in magnetism

- headingAccuracy will be reported as a negative
- Extreme magnetic exposure triggers
  - `kCLErrorHeadingFailure`
- Calibration movement is needed to improve



Heading Accuracy

Movement improves accuracy

- Calibration is the way iPhone filters interference
- Rotating iPhone calibrates
- iPhone calibrates interference that moves with it

Compass Interference

Using the built-in message

"Move away from any interference, or re-calibrate by waving iPhone in a figure 8 motion"

Message is optional

- Automatically dismissed when calibrated
- Manually dismissed with method call

Direction Summary

- Course and Heading
- Magnetic North and True North
- Using the Heading API
- Heading Accuracy

Using Core Location

Beyond navigation

Beyond Navigation

Tips and Use Cases

- Additional Uses for Compass
- Supporting Multiple Platforms
- Core Location and MapKit

Beyond Navigation

Compass provides horizontal for virtual reality

Beyond Navigation

Compass provides horizontal for virtual navigation

Compass and Augmented Reality

Beyond Navigation

Reconstructing media with positioning information

270 ° W

0 ° N

90 ° E

iPhone Compass

Calculates direction with respect to hardware

Demo

Supporting Multiple Platforms

Do not judge a book by its cover

- iPod touch + GPS
  - External accessories can extend location capabilities
  - Check device capabilities instead of limiting to particular hardware
- Mac without a WiFi card

MapKit

New framework for embedding maps

- Provides map views
- Uses Core Location
- Reverse geocoding

Core Location and MapKit

Choosing a framework for your use case

	Core Location	MapKit
Location	✓	✓
Compass	✓	
Turn By Turn	✓	
Map Views		✓
Reverse Geocoding		✓

Overall Summary

- Finding your location
- Finding your direction
- Beyond navigation
  - Additional uses for Compass
  - Supporting multiple platforms
  - Core Location and MapKit

More Information

Matt Drance
Application Frameworks Evangelist
mdrance@apple.com

Documentation
Core Location Framework Reference
http://developer.apple.com/iphone

Labs

Core Location Lab	iPhone Lab B Thursday 3:30PM

Related Sessions

iPhone Web Applications from Start to Finish	Russian Hill Tuesday 2:00PM
Embedding Maps in iPhone Applications	Presidio Thursday 10:30AM

Q&A

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WWDC09